Course Title	**Biochemistry II**				
Course Code	**MED-209**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 2/ Semester 4 (Spring)				
Teacher's Name	**Course Lead:** Dr Chloe Antoniou **Contributors:** Dr Stella Voskou				
ECTS	6	Lectures / week	3	Laboratories / week	2
Course Purpose and Objectives	The aim of this course is to provide students with an in-depth understanding of fundamental principles biochemistry, cell and molecular biology topics. This course is the second course of a series of two biochemistry courses and starts of with section on metabolism and nutrition which serves as a continuation of the first course. The second part of the course focused on fundamental topics of cell and molecular biology. The specific objectives of the course will be accomplished through lectures, laboratory sessions and tutorials in order for students to not only understand the material, but also develop skills in order to apply their knowledge.				
Learning Outcomes	The following list provides the learning objectives that will be covered in the lectures, laboratory practicals and tutorials of each week: **Week 1** ***LOBs covered during lectures:*** 1. Discuss the overall aims of the lab project 2. Describe and explain the experiments used in the lab project. 3. Discuss how to interpret potential results. 4. Describe the reactions of the pentose phosphate pathway and its regulation. 5. Discuss disorders related to the pentose phosphate pathway such as glucose 6-phosphate dehydrogenase deficiency. 6. Discuss the metabolism of purines and pyrimidines. 7. Describe the role of chemotherapy drugs in nucleotide metabolism. 8. Discuss disorders of nucleotide metabolism. ***LOBs covered during laboratory practical:*** 9. Isolate genomic DNA from saliva and perform a polymerase chain reaction (PCR) experiment on the isolated DNA				

Week 2

LOBs covered during lectures:

10. Define basic concepts in nutrition e.g. essential nutrients, balanced diet, recommended daily allowance, body mass index etc.
11. Describe the functions of vitamins A, C, D, E and K.
12. Describe the functions of the B vitamins and discuss examples of metabolic reactions that require them.
13. Discuss vitamin deficiencies and toxicities.
14. Discuss the metabolism of phospholipids and its regulation.
15. Discuss the metabolism of sphingolipids and its regulation.
16. Discuss the metabolism of eicosanoids and its regulation.
17. Discuss the term "essential fatty acids".
18. Outline the metabolism of eicosanoids and its importance to humans.

LOBs covered during laboratory practical:

Isolate genomic DNA from saliva.

Week 3

LOBs covered during lectures:

19. Discuss ethanol metabolism and the metabolic effects of chronic alcohol abuse.
20. Discuss the metabolism of steroids (hormones, cholesterol, vitamin D etc) and its regulation.
21. Discuss the structure, function and metabolism of creatine.
22. Discuss the structure, function and metabolism of glutathione.
23. Discuss the structure, function and metabolism of S-adenosylmethionine.
24. Discuss the structure, function and metabolism of GABA.
25. Discuss the structure, function and metabolism of heme.
26. Discuss the structure, function and metabolism of nitric oxide.
27. Discuss the structure, function and metabolism of catecholamins.
28. Discuss the structure, function and metabolism of histamine.
29. Discuss the structure, function and metabolism of melanin.
30. Discuss the structure, function and metabolism of peptide hormones such as insulin, thyroid hormones and hormones of the renin-angiotensin system.

LOBs covered during laboratory practical:

Carry out a PCR on the genomic DNA from saliva.

Week 4

LOBs covered during lectures:

31. Describe the metabolic reactions carried out in lysosomes and their related disorders.

32. Describe the metabolic reactions carried out in peroxisomes and their related disorders.

33. Revise basic principles of transcription, translation and recombination.

LOBs covered during laboratory practical:

34. Perform a restriction digestion of the PCR product of the previous experiment.

Week 5

LOBs covered during lectures:

35. Outline methods used in determining DNA sequences using dideoxy sequencing and RFLP analysis.

36. Describe applications of DNA sequencing.

37. Outline methods in high throughput sequencing and their applications.

38. Discuss the applications of recombinant protein technologies in medicine.

39. Discuss how bacteria, yeast and other organisms can be used in recombinant technologies.

40. Discuss techniques used in recombinant protein technologies such as plasmid construction.

41. Outline commonly used blotting techniques.

42. Discuss ways to quantify gene expression both at the mRNA and protein levels.

43. Explain how to experimentally determine gene expression at the mRNA level using techniques such as quantitative reverse transcription PCR.

44. Explain how to experimentally determine gene expression causing techniques such as Western blots, ELISA and fluorescence microscopy.

LOBs covered during laboratory practical:

45. Perform DNA electrophoresis on the digestion products from the previous experiment.

LOBs covered during practical/tutorial:

Problem solving

Week 6

Revision for midterms exams.

LOBs covered during practical/tutorial:

Problem solving

Week 7

Formative Midterm Exam

Week 8

Feedback on formative exam

LOBs covered during lectures:

46. Describe the co-translational and post-translational protein sorting pathways.

47. Discuss disorders that results from improper protein targeting.

48. Discuss the different types of post translational modifications such as proteolytic cleavage, phosphorylation and acetylation amongst others.

49. Discuss examples for each type of post translational modification and discuss their importance.

50. Explain O- and N-linked glycosylation.

51. Discuss medically relevant examples of glycosylated proteins such as erythropoietin and the ABO blood group system.

52. Describe the function of ubiquitin and the process of ubiquitination.

53. Explain what types of proteins are ubiquitinated and how ubiquitin is attached onto them.

54. Discuss how the proteosome breaks down ubiquitinated proteins.

55. Discuss the synthesis and post translational modifications of collagen.

56. Explain how proteins are targeted to different cellular locations.

Week 9

LOBs covered during lectures:

57. Explain the different types of DNA repair mechanisms and provide examples of each one.

58. Discuss how errors in repair mechanisms can result to cancer.

59. Discuss the checkpoints of the cell cycle.

60. Explain how the cell cycle is regulated and how errors in regulation may result to cancer.

61. Define and provide examples of tumor suppressor genes and oncogenes.

62. Describe the role of p53 in cancer.

63. Discuss the role of viruses such as HPV in cancer.

LOBs covered during tutorial:

Problem solving

Week 10

LOBs covered during lectures:

64. Define apoptosis and necrosis and discuss their differences.

65. Define causes of cell injury and necrosis and describe pathologic processes (e.g. liquefactive necrosis and free radical formation.

66. Discuss the different types of apoptotic pathways.

67. Discuss chemotherapy drugs as inducers of apoptosis and inhibitors of the Cell Cycle.

68. Discuss the role of genes commonly associated with different types of cancer.

69. Discuss the different chromosomal translocations that lead to cancer formation.

70. Describe local and long distance signalling.

71. Describe the different types of receptors and give examples of each one.

72. Explain the basic principles of receptor-ligand binding.

73. Describe the general structure of G protein coupled receptors (GPCRs).

74. Describe the b-adrenergic receptor signalling pathway as an example of a GPCR signalling pathway.

75. Discuss the process of GPCR receptor desensitization.

76. Discuss the phosphoinositide pathway of the b-adrenergic receptor signalling.

Week 11

LOBs covered during lectures:

77. Describe the structure of tyrosine kinase receptors.

78. Explain the MAPK signalling pathway of the insulin receptor.

79. Discuss the phosphoinositide 3-kinase branch point of insulin signalling.

80. Discuss the guanylyl cyclase family of tyrosine kinase receptors and provide examples.

81. Discuss signal transduction of cytokine receptors via the JAK-STAT tyrosine kinase receptors.

82. Discuss the structure and function of serine-threonine kinases.

	83. Discuss signalling via serine-threonine kinases such as TGF-b. ***LOBs covered during tutorial:*** Problem solving **Week 12** ***LOBs* covered during lectures*:*** Revision		
Prerequisites	MED-204 Biochemistry I	Required	None
Course Content	**<u>Topics covered in lectures:</u>** • The pentose phosphate pathway. • Nucleotide metabolism. • Vitamins and minerals. • Metabolism of phospholipids, sphingolipids and eicosanoids. • Alcohol metabolism & Metabolism of Steroids. • Metabolism of amino acid derivatives and peptide hormones. • Lysosomes and related disorders. • Peroxisomes and related disorders. • Revisiting DNA replication, recombination, transcription and translation. • Molecular biology techniques. • Protein sorting. • Post-translational modifications. • DNA repair. • The cell Cycle: regulation and implications in cancer. • Oncogenes and tumor suppressor genes. • Apoptosis and necrosis. • Signal transduction I: basic principles. • Signal transduction II and III: G Protein Coupled Receptors. • Signal Transduction IV: Enzyme Coupled Receptors -Tyrosine Kinase Receptors. • Signal Transduction V: Enzyme Coupled Receptors -Receptor serine-threonine kinases. **<u>Topics covered in lab practicals:</u>**		

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Isolation of DNA & Polymerase chain reaction (PCR).
Restriction digestion of PCR products.
DNA electrophoresis.

<u>Topics covered in tutorials:</u>

Introduction to lab project.
Problem solving.

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<tr><td>Teaching Methodology</td><td>Lectures, Tutorials, Laboratory Practical Sessions.</td></tr>
<tr><td>Bibliography</td><td>
Required Textbooks/Reading
<table>
<tr><th>Authors</th><th>Title</th><th>Edition</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>David L. Nelson and Michael M. Cox</td><td>Lehninger Principles of Biochemistry</td><td>8th edition</td><td>W. H. Freeman and Company</td><td>2021</td><td>9781319381493 (paperback)</td></tr>
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Recommended Textbooks/Reading
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<tr><th>Authors</th><th>Title</th><th>Edition</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>Roger L Miesfield and Megan McEvoy</td><td>Biochemistry</td><td>2nd Edition</td><td>W.W. Worton & Company</td><td>2021</td><td>9780393533538 (paperback)</td></tr>
<tr><td>Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter</td><td>Molecular Biology of the Cell</td><td>7th Edition</td><td>Norton & Company</td><td>2022</td><td>9780815344643 (paperback)
9780393884852</td></tr>
<tr><td>Michael A. Lieberman and Rick Ricer</td><td>BRS Biochemistry, Molecular Biology & Genetics</td><td>7th Edition</td><td>Lippincott Williams & Wilkins</td><td>2019</td><td>9781496399236</td></tr>
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<tr><td>Assessment</td><td>For the course MED-209 Biochemistry II there will be a Formative Midterm Exam. The grade for the course will be contributed by a Lab Report (20%) and a Summative Final Exam (80%). Written exams consist of Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).</td></tr>
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Language	English